Next Generation Gamma-Ray - Compton

[Draft - 07/25/11]

Name of Technology (256 char)	Si, Ge, CZT or CdTe strip detectors	ASICS	Active Cooling
Brief description of the technology (1024)	High spectral resolution is needed to obtain nucleosynthesis signatures and spatial resolution is needed to isolate sources and maximize signal to noise. This leads to Compton telescope designs with solid state detector arrays. Si, CZT and CdTe do not need cooling. Ge delivers better resolution.	Low power ASICs are needed to provide accurate energy for each photon but with low aggregate power per square meter.	Germanium arrays need active cooling below 100K, but on the scale needed for a Compton telescope this is a challenge.
Goals and Objectives (1024)	The goal is to reach TRL 6 in 2015, to meet opportunities for near-term explorers	The goal is to reach TRL 6 by 2015	The goal is to reach TRL 6 by 2015
TRL	TRL is between 4 and 5 depending on whether it is Si, CZT, CdTe or Ge. Requires efforts towards space qualification and testing in relevant environment.	TRL is essentially undefined until the detector is specified. The ASIC is specific to the detector and developed in co-evolution with it.	TRL is between 4 and 5. Primary effort is achieving large scale in heat removal per unit time, followed by space qualification and testing in relevant environment.
Tipping Point (100 words or less)	Designs have reached TRL 4. A focused effort could increase this to TRL 6. A few cycles of fabrication and test are realistically necessary, but must be coordinated with ASIC development.	Pixel designs require custom ASIC development to meet targets for power combined with noise level.	If a breakthrough in refrigeration is not achieved, Ge will tend to be eliminated in favor of the room temperature semiconductor options
NASA capabilities (100 words)	NASA's capabilities support test but strip arrays are custom procurements from commercial sources.	NASA has engineering groups producing custom ASICs at GSFC but suitable groups also exist in DoE or at commercial sources.	Refrigeration development capabilities exist in NASA but also in industry.
Benefit/Ranking	Ranking iv.The detector array is the primary factor determining system performance, setting the size scale, sensitivity and other factors, enabling the entire mission concept, hence the science.	Ranking ii. Detector capability alone without an ASIC suitably matched to it could lead to prohibitive system power and make the concept unworkable. Multiple turns of development are likely needed.Ranking: TBD	Ranking iii. Solving refrigeration for this application would conceivably be enabling for other missions
NASA needs/Ranking	NASA needs a next generation medium-energy gamma-ray mission to advance understanding of nuclear astrophysics and black hole sources. Solar physics and lunar prospecting are other applications.	The detector alone is not sufficient and requires the ASIC. If the material is Ge, the ASIC is probably external to the refrigeration, but still needs to be low power.	Refrigeration is a general need for germanium detectors in space use

Next Generation Gamma-Ray - Compton

Non-NASA but aerospace needs	Such devices might have applied uses, including charged particle and other environmental monitoring done from space platforms	ASICs are an integral part of the system hence contribute similarly to detectors for non-NASA needs.	
Non aerospace needs	Detector systems might have use in sea-level environmental monitoring e.g., for nuclear materials as well as nuclear medicine,etc. Ranking iv	ASICs are an integral part of the system hence contribute similarly to detectors for non-aerospace needs; Ranking iv	
Technical Risk	Technical risk is low. The design principles are generally understood but progress comes through design iterations to refine performance based on completed units. Cost risk may drive material preferences. Ranking ii	Technical risk is low to moderate given access to (rare) analog ASIC design expertise. The history of analogous flight projects shows this task must not be underestimated.The main challenge is to get low power with low noise. Ranking ii	
Sequencing/Timing	Should come as early as possible. Development of other system components depends on detector unit parameters. Only modest programs in Ge and CZT are ongoing. Ranking iv	ASIC design must be matched to design of the detector element and cannot precede it, but should be roughly simultaneous.	Refrigeration system needs to be designed as part of mission system engineering
Time and Effort to achieve goal	Ranking iv.Minimal effort. 3 year collaboration between industry and NASA	Ranking iv.Minimal effort. 3 year collaboration between industry and NASA	Ranking iii. Moderate effort, 3 year collaboration between industry and NASA